Washington State Department of Transportation

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Improving Highway Safety:

Deception Pass Log Rail

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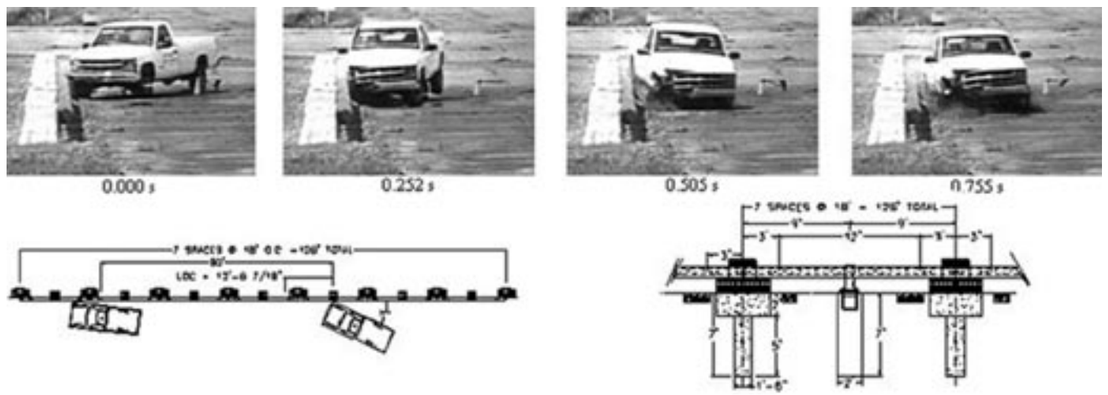
Crash test

The new barrier design was successfully crash tested in accordance with the NCHRP Report 350 (1) requirements for Test Level 2.

This barrier can be used in other locations where an aesthetic barrier is desired and the posted speed is 45 mph or less.



General Information
- Test Agency ..... Texas Transportation Institute
- Test 1 400561-2
- Date 06/14/2004

Test Article
- Type ..... Guardrail
- Name ..... Deception Pass State Park Log Rail
- Installation Length (ft) ..... 126.0 (38.4 m)
- Material or Key Elements ..... Steel-Backed Log Rail
- Supported by Stone Bollards and Steel Pipe Posts

Soil Type and Condition ..... Standard Soil, Dry

Test Vehicle
- Type ..... Production
- Designation 2000P
- Model ..... 1989 Chevrolet 2500 Pickup

Truck
- Mass (lb)
  - Curb ..... 4758 (2160 kg)
  - Test Inertial ..... 4529 (2056 kg)
  - Dummy ..... N/A
  - Gross Static ..... 4529 (2056 kg)

Impact Conditions
- Speed (mph) ..... 44.7 (71.9 km/h)
- Angle (deg) 25.0

Exit Conditions
- Speed (mph) ..... 22.0 (35.4 km/h)
- Angle (deg) 6.5

Occupant Risk Values
- Impact Velocity (ft/s)
  - Longitudinal ..... 23.0 (7.0 m/s)
  - Lateral ..... 16.7 (5.1 m/s)
- THIV (km/h) 29.7
- Ridedown Accelerations (g's)
  - Longitudinal ..... -4.2
  - Lateral ..... -3.9
- PHD (g's) 7.1
- ASI 1.09

Max. 0.050-s Average (g's)
- Longitudinal ..... -8.9
- Lateral ..... -6.8
- Vertical ..... -4.3

Test Article Deflections (ft)
- Dynamic ..... N/A
- Permanent ..... Disturbed
- Working Width ..... 1.6 (0.5 m)

Vehicle Damage
- Exterior
  - VDS 01RF2
  - CDC 01RFEW2
  - Maximum Exterior Vehicle Crush ..... 23.6 (inches) ..... (600 mm)
- Interior
  - OCDI RF0104000
  - Maximum Occupant Compartment Deformation ..... 2.5 (inches) ..... (63 mm)

Post-Impact Behavior (during 1.0 sec after impact)
- Max. Yaw Angel ..... -33 (deg)
- Max. Pitch Angle ..... -4 (deg)
- Max. Roll Angle ..... -7 (deg)

References

1. *H.E. Ross, Jr., D.L. Sicking, R.A. Zimmer, and J.D. Michie, Recommended Procedures for the Safety Performance Evaluation of Highway Features, National Cooperative Highway Research Program Report 350, Transportation Research Board, National Research Council, Washington, D.C., 1993.*
2. *O.W. Jepperson, W.F. Williams, R.B. Albin, D.L. Bullard, Deception Pass Log Rail, Presented at 84th Annual meeting of the Transportation Research Board, November 2004.*

04-12-0419

Washington State Route 20 is an NHS highway providing the most northerly east-west route in Washington State. In Northwest Washington, SR 20 passes through Deception Pass State Park and provides the only highway connection between Whidbey Island and the mainland.

"The historic guardrails are a significant element of the character of Deception Pass State Park and help create a desirable vista."

Richard J. Clifton, Washington State Parks and Recreation Commission.

Original CCC log rail.

Deception Pass State Park is a 4,134-acre marine and camping park with 77,000 feet of saltwater shoreline, and 33,900 feet of freshwater shoreline on four lakes. Two bridges carry SR 20 over Deception and Canoe passes. The park includes sheer cliffs, water views, old-growth forests and abundant wildlife and is the most popular state park in Washington.

The portion of SR 20 within the park was constructed by the Civilian Conservation Corps (CCC) in the mid 1930's. As part of this work, the CCC constructed a stone masonry bollard and log rail system to delineate the edge of the road and prevent early model vehicles from leaving the roadway. Due to their age, quality of workmanship, and importance to the surroundings, the bridges and log rails are eligible for the National Register of Historic Places.

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Deception Pass Log Rail

Accident History

The highway usage has changed significantly since the Civilian Conservation Corps (CCC) built the road in the mid 1930's. Currently, the Average Daily Traffic volume is 15,000 vehicles per day and the 85 percentile speeds vary between 36 and 45 MPH.

Within the 2-mile segment of SR 20 inside Deception Pass State Park, the number of accidents per year has more than doubled from 1980 to 2000. Fifty percent of the accidents involved vehicles hitting fixed objects on the roadside. Nearly half of these accidents involved the CCC rail.

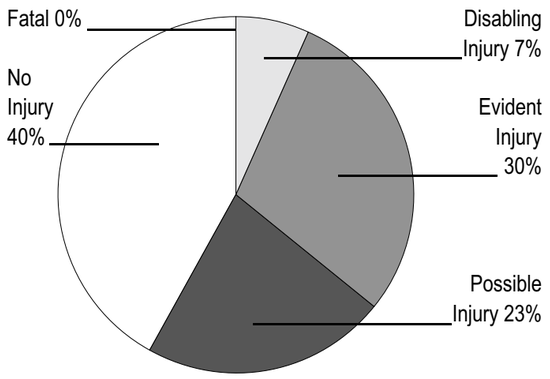
In addition to the increased number of injury accidents, the repair of the CCC rail is very difficult. In many cases, the rock bollards have been destroyed.

To address safety concerns, the WSDOT proposed replacing the rail with a crashworthy system. However, there was significant concern expressed by the Washington State Parks and Recreation Commission (WSPRC) and the State Historic Preservation Office.

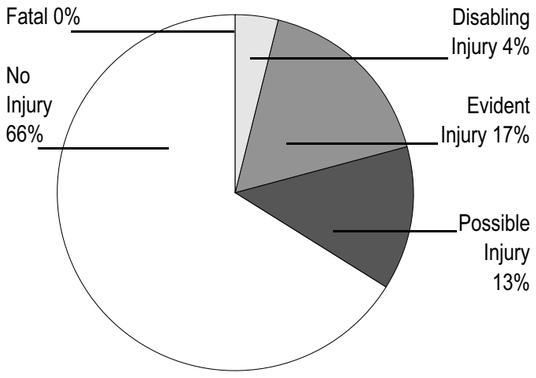
CCC rail after an impact.

As shown below, the number of injury accidents was significantly higher when the CCC rail was involved and the number of disabling injury accidents was nearly doubled.

Severity of Accidents Involving the CCC Rail



Severity of Hit Fixed Object Accidents Not Involving the CCC Rail

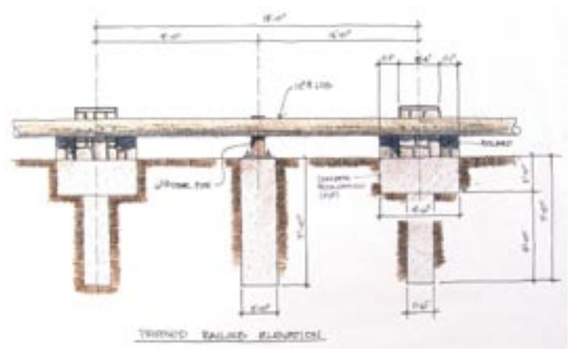


Design Process

To develop an acceptable solution, a team was created that included the WSPRC and the other interested parties. This team met several times to discuss the need to replace the rail and options to minimize the impacts. After analyzing the accident history, the team agreed that replacement of the rail was necessary. However, after gaining an understanding of the importance of the historical and aesthetic concerns, the team also agreed that a typical barrier system was not appropriate in this setting.

With this understanding, the team developed the following "character defining features" of the CCC rail.

1. The bollards (supports) are constructed of rock and mortar
2. The bollards have a distinctive shape
3. Ability to see over and under the rail
4. The log rails are wood
5. The bollard spacing is about 18 feet
6. Bollards are non-uniform
7. The log is discontinuous and aligned at the center of the bollards
8. The log rail sits on the bollard's shoulders
9. The logs have taper
10. The spacing of the bollards is non-uniform.



"(This) design captures many of the character defining features present in the original CCC product, yet incorporates low maintenance, durability and safety features required today."

Terry Doran, Northwest Region Manager, Washington State Parks and Recreation Commission

The Texas Transportation Institute (TTI) designed a barrier that incorporated 6 of the 10 character defining features.

This barrier design was accepted by the stakeholders for the WSPRC and the State Historic Preservation Office

"I am impressed by the time, dedication and concern of the Washington State Department of Transportation, which has been sensitive to the historical and aesthetic concerns of those of us who often travel that road and love the beauty of the area. I think this concern for safety, while acknowledging the importance of history and aesthetic, is impressive and I am grateful the 'easy solution' was not considered 'good enough'."

Excerpt from a letter from a resident regarding the new barrier.